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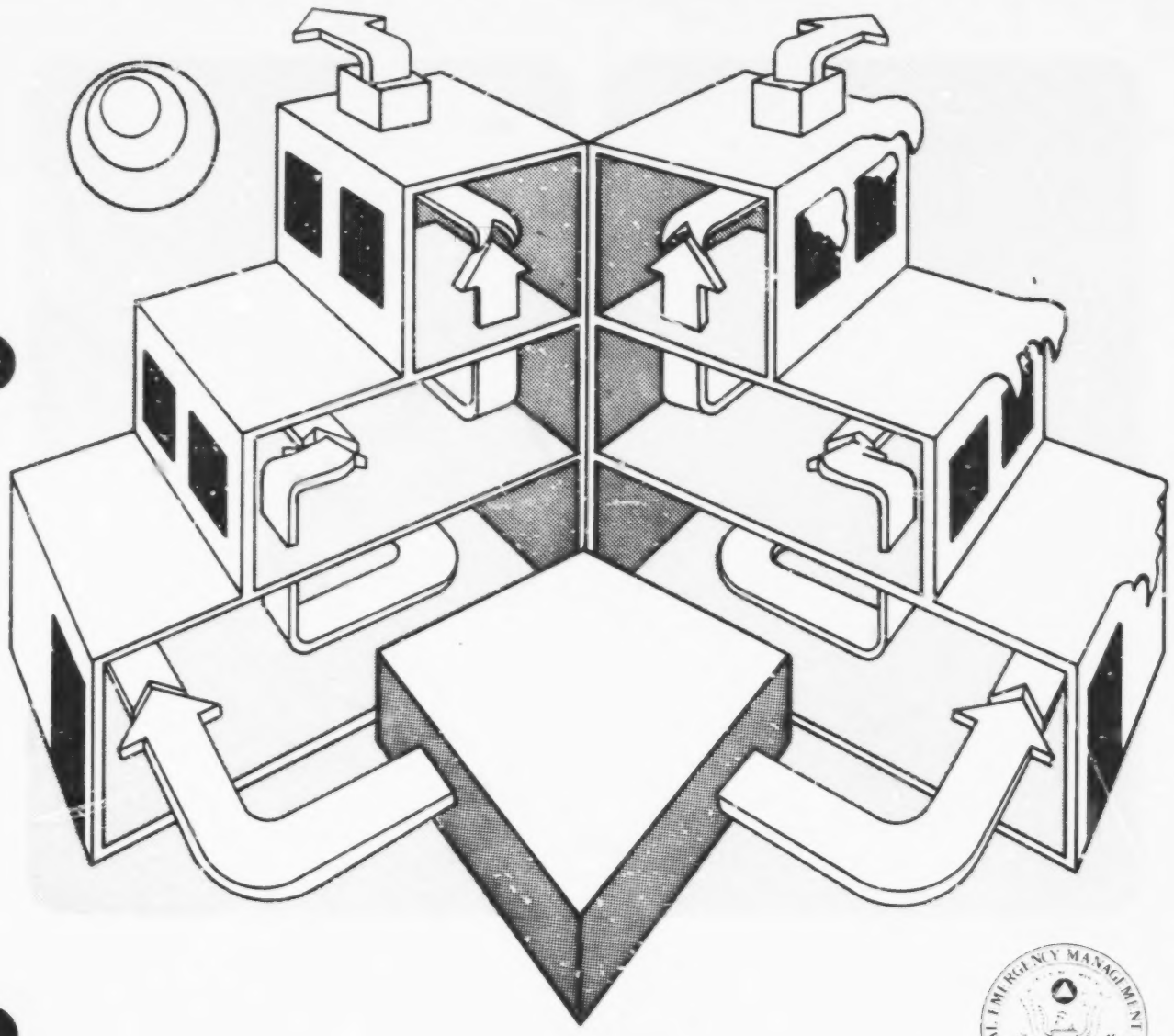
Maintenance Manual

Heating, Ventilating & Air Conditioning (HVAC) System for Emergency Operations Center



COMPLETED

MAINTENANCE MANUAL

HEATING, VENTILATING & AIR CONDITIONING (HVAC) SYSTEM FOR EMERGENCY OPERATIONS CENTER

Federal Emergency
Management Agency

Maintenance Manual
Heating, Ventilating, & Air Conditioning (HVAC)
System for Emergency Operations Center

Introduction

The purpose of this manual is to guide you on how to maintain the heating, ventilating, and air conditioning equipment in your emergency management center (EMC). The information in this manual is only a **supplement** to the recommended maintenance information supplied in the service manuals provided by the manufacturers of the equipment. **Always follow the maintenance procedures provided in the manufacturer's manuals**. This manual will help you understand why maintenance is necessary. This will also be helpful if the manufacturer's maintenance manuals are not immediately available.

Description of a HVAC System

An emergency management center, by its very nature, will be unoccupied for a great deal of time, except for occasional maintenance work. A HVAC system in an isolated center creates a normal environment to protect equipment from damage. The development of a maintenance routine for an isolated HVAC system is crucial, due to a lack of day-to-day monitoring. If the center is located in a heavily used public building, the maintenance of the HVAC system for the entire building should be examined.

HVAC systems control the indoor environment by heating, cooling, cleaning and humidifying air.

There are a number of different heating systems, in which heat from a furnace warms water or air, or generates steam. This heat is then distributed by fans, pumps, or gravity throughout a building. Warm air systems (which heat air & then force it around a building by fans & ducts) are the most common. Air conditioning systems are quite varied, cooling the interior environment by passing air around some form of heat absorber. Both heating and air conditioning equipment clean and humidify the air in the process of altering its original temperature.

It is beyond the scope of this manual to detail the maintenance needs of every type of HVAC system. HVAC systems are combined in many ways and integrated with a building's design. Every installation is customized to the particular needs of a building and its occupants relative to its external environment. A maintenance program essentially should examine the mechanical response of a HVAC system to seasonal demands and responses, noting how the responses create a controlled indoor environment.

Preventive Maintenance

To ensure that the components of your HVAC system work normally & in an emergency, you should develop a program where you **regularly check the equipment to spot small troubles before they become big problems.** A program of coordinated monthly, semiannual and annual maintenance checks prevent serious problems from suddenly happening.

Routinely clean the equipment. Check for frayed connections and loose bolts and parts; inspect the switches, controls, and circuits. These checks are not normally mentioned in manufacturer's manuals, but can lead to more serious problems.

Equipment and Spare Parts

Only ordinary mechanical and electrical tools are needed to perform most maintenance on this equipment. Specialized tools are required to check and refill with refrigerant; consult a HVAC technician for specific equipment needs for your system.

Maintain a list of spare parts for each piece of equipment. The following table gives you an example of a list of commonly needed parts for a forced air furnace in a medium-sized building.

Spare Parts: Heating System

Names of part	Quantity
filter	1 set
burner & manifold assembly	1
pilot burner	1
gas opening	1 set

Safety

Follow safety precautions outlined in maintenance manuals supplied by the manufacturer.

Avoid moving parts; do not expect a system's safety devices to protect you.

Only a qualified electronics technician should attempt to repair any serious electrical problems, since these systems carry high voltages.

Monthly Maintenance Checks: Air Conditioning Equipment

1) Check compressor for liquid pumping by taking discharge temperature.

2) Inspect compressor and shaft seals for evidence of gasket or seal failure. Replace defective gaskets or seals.

3) Stop compressor and inspect level and condition of crankcase oil. Refill or replace oil when necessary. If compressor has forced-fed lubrication, check oil pump pressure gauge.

4) Inspect compressor motors for cleanliness, proper operation, and lubrication. When necessary, clean motor housing and lubricate motor bearings.

5) Inspect compressor drives for pulley alignment and belt tension and condition. Replace defective belts.

Monthly Maintenance Checks: Motors

1) Inspect motors and shafts for adequate lubrication. Add oil or grease when necessary. Follow manufacturer's recommendations.

2) Clean or replace filters.

3) Disassemble and renovate equipment.

4) Check the temperature and relative humidity in selected rooms, with a sling psychrometer or indoor temperature/humidity recorder.

Monthly Maintenance Checks: Fans

1) Inspect for proper operation, balance and cleanliness. Check fan wheels for alignment and freedom of rotation. Check fan blades for cleanliness and for damage.

Monthly Maintenance Checks: Filters

1) Inspect filters for cleanliness. Clean or replace when necessary.

Monthly Maintenance Checks: V-Belts

1) Inspect V-belts for breaks, evidence of wear, and proper tension. Replace damaged belts.

2) **Check pulleys for proper alignment and cleanliness.** Adjust & clean when necessary.

6-Month Maintenance Checks: Heating Unit

1) Check vent screen and building pressure regulator vent for free breathing and escaping gas. Clean dirt and remove obstructions from vent, if necessary. If gas is escaping, shut off gas line and arrange for immediate replacement or repair of diaphragm. Check outlet gas pressure with U-gauge.

2) Examine operation of pilots. Make sure that lighting-pilot flame is in proper position for ignition of main burners. Check safety devices using manufacturer's instructions.

3) Test boiler gas pressure regulator with U-gauge. Adjust, if required (gas pressure affects burner flame size).

4) Check the primary controls of the gas burner. Observe operation of solenoid, diaphragm and motorized valves through a complete cycle. Examine external levers & auxiliary dampers of valves, if used.

5) Look for gas leaks on tubing and piping. Cover tubing with a soapy solution and watch for bubbles. **Do not use a flame.**

6) Observe burner operation. Clean air mixer and burner parts. Re-adjust air shutter, if necessary. Inspect and clean gas opening; replace, if required.

7) Examine condition of fire for compliance with operating conditions. Analyze boiler-exit flue gas for carbon monoxide (CO) content (low CO content indicates presence of air leak).

6-Month Maintenance Checks: Air Conditioning Equipment

1) Test for leaking compressor discharge and suction valves. Repair leaky valves.

6-Month Maintenance Checks: Motors

1) Check fan and motor bearings for adequate lubrication. Add grease or oil when necessary. Follow manufacturer's recommendations.

2) Clean unit.

6-Month Maintenance Checks: Fans

1) Tighten bolts and nuts around duct connections, fan housing, and floor or equipment connections.

2) Lubricate fan bearings.

3) Disassemble fan as you clean and inspect components. Repair or replace damaged equipment.

6-Month Maintenance Checks: Ducts

1) Inspect ducts for deformation, leakage losses, and presence of dust. Repair & clean when necessary.

6-Month Maintenance Checks: Roof Monitors & Attic Louvers

1) Examine roof monitors and attic louvers for damage. Repair and/or replace as necessary.

12-Month Maintenance Checks: Air Conditioning Equipment

1) Disassemble compressor, cleaning and replacing parts as necessary. Change oil if contaminated.

12-Month Maintenance Checks: Motors

1) Clean and repack motor bearings. Follow manufacturer's recommendations.

12-Month Maintenance Checks: Ducts

1) Clean and paint ducts.

12-Month Maintenance Checks: Hoods

1) Inspect hoods for damage, poor connections to exhaust ducts, and presence of dust. Repair & clean when necessary.

2) Clean and paint hoods.

12-Month Maintenance Checks: Roof Monitors & Attic Louvers

1) Paint roof monitors and attic louvers, when necessary.

Corrective Maintenance: Troubleshooting

Some equipment malfunctions may be discovered during inspection or in the actual use of the HVAC system. Perform the tests on the following table to locate, and possibly correct, the problem.

PLEASE NOTE: This manual does not attempt to list all possible malfunctions that could occur nor can we suggest all possible remedies. Consult the manufacturer's manuals if a malfunction is not listed or it is not corrected by a prescribed procedure.

Corrective Maintenance: HVAC Systems (Part 1 of 6)

Malfunction	Possible Cause	Recommendation
1. Insufficient heat supply	■ plugged air filter	■ clean or replace air filter
	■ blower not operating.	■ blown fuse in motor, electrical supply. Find fuse; eliminate cause of blown fuse.
	■ overload or low voltage of motor starter	■ find and eliminate cause
	■ open circuit due to faulty connection	■ remake connection properly
	■ short circuit in supply line windings	■ repair as requireo
	■ blower running in wrong direction	■ reverse connection
	■ blower running too slow. Low voltage at motor terminals.	■ find & correct cause of low voltage
	■ load too high	■ reduce load or increase motor size
	■ defective windings	■ repair as required
	■ air regulating dampers closed or partially closed	■ adjust dampers

Corrective Maintenance: HVAC Systems (Part 2 of 6)

Malfunction	Possible Cause	Recommendation
1. Insufficient heat supply (cont.)	■ obstruction of ducts or registers	■ clear obstruction
	■ insufficient air temperature	■ check operation of firing equipment & controls. Adjust & repair as required.
2. Rooms alternately cold & hot	■ blower control set too high	■ reset blower control
	■ defective thermostat	■ adjust or replace thermostat
3. Blower goes on & off too frequently	■ too small a differential between start & stop setting on blower control	■ readjust blower control
4. Blower control does not work	■ faulty contacts	■ inspect & replace contacts as necessary
5. Compressor runs continuously; good refrigeration effect	■ air over the condensor restricted	■ remove constriction or provide for more air circulation over the condensor
6. Compressor runs continuously; unit	■ thermostatic switch contacts badly burnt	■ replace thermostatic switch
	■ thermostatic switch bulbs has become loose	■ secure bulb in place
	■ thermostatic switch improperly adjusted	■ readjust thermostatic switch

Corrective Maintenance: HVAC Systems (Part 3 of 6)

Malfunction	Possible Cause	Recommendation
7. Compressor runs continuously; little refrigeration effect	■ dirty condenser	■ clean condenser
	■ no air circulating over condenser	■ provide air circulation
	■ ambient temperature too high	■ provide ventilation or move to a cooler location
	■ load too great	■ analyze load
8. Compressor runs continuously; no refrigeration	■ restriction prevents refrigerant from entering the evaporator	■ locate restriction & remove, by jarring or heating. Replace unit if restriction does not open
	■ compressor not pumping	■ replace unit
	■ refrigerant low	■ refill, following manufacturer's instructions
9. Compressor short cycles, poor refrigeration effect	■ loose electrical connections	■ locate loose connections & make them secure
	■ defective thermostatic switch	■ replace switch
	■ defective motor starter	■ replace defective motor starter or relay
	■ air restriction at evaporator	■ remove air restriction

Corrective Maintenance: HVAC Systems (Part 4 of 6)

Malfunction	Possible Cause	Recommendation
10. Compressor short cycles, no refrigeration	■ dirty condenser	■ clean condenser
	■ ambient temperature too high	■ provide ventilation or move to a cooler location
	■ defective wiring	■ repair or replace defective wiring
	■ thermostatic switch operating erratically	■ replace switch
	■ relay erratic	■ replace relay
11. Compressor runs too frequently	■ poor air circulation around the condenser or too high ambient temperature	■ increase air circulation around the condenser
	■ load too great	■ analyze end use
	■ worn compressor	■ repair or replace the unit
12. Compressor not operating	■ motor not operating	■ check motor with ammeter
	■ oil on top of the of the piston	■ wait an hour or so, then attempt to start motor by turning current on & off many times
	■ compressor may be stuck, or some parts may be broken	■ replace the unit
	■ compressor may broken on the inside of the units, or the motor winding may be open	■ replace the unit

Corrective Maintenance: HVAC Systems (Part 5 of 6)

Malfunction	Possible Cause	Recommendation
13. Compressor is unusually hot	■ dirty condenser or lack of air circulation	■ clean condenser and/or increase air circulation
	■ unusually heavy service or load	■ if possible, decrease load. Perhaps another unit is needed.
	■ low voltage	■ feed wires too small; replace with larger ones
	■ loss of oil	■ add oil; if not possible, replace the unit
14. Lack of refrigeration after long shut-down or on delivery	■ liquid refrigerant leaked into compressor's crankcase	■ allow compressor to operate until its internal heat drives off refrigerant; may take up to 24 hrs.
15. Compressor noisy	■ mountings worn or deteriorated	■ replace mountings
	■ shortage of oil and/or refrigerant	■ add oil and refrigerant. If not possible, replace the unit.
	■ the sealed unit mechanism has become worn	■ replace the unit

Corrective Maintenance: HVAC Systems (Part 6 of 6)

Malfunction	Possible Cause	Recommendation
16. After each defrosting there is a long on-cycle before normal refrigeration	■ dirty condenser	■ clean condenser
	■ slight shortage of refrigerant	■ if possible, add refrigerant. If not, replace the unit.
	■ thermostatic switch bulb is loose	■ secure the bulb in place
	■ restriction between receiver or condenser and/or evaporator	■ remove restriction by jarring or heating. If this does not correct the problem, replace the unit.
	■ compressor not pumping to full capacity	■ repair or replace the unit

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